REVIEW

on a dissertation for obtaining an educational and scientific degree "Doctor"

Author: Milena Filipova Grueva
Topic "Group control of robotic vehicles for freight transport"
Subject matter: 5. Technical sciences,
Direction: 5.2. Electrical engineering, electronics and automation
Scientific specialty: "Automated systems for information processing and control"
Jury member: Prof. Dr. Todor Dimitrov Neshkov, Technical University - Sofia

The dissertation has a volume of 151 pages, divided into 4 chapters and a conclusion. 101 literature sources are cited, incl. internet addresses. In connection with the dissertation, 9 publications were presented with the participation of the doctoral student. Of these, 1 is in a journal abroad, 6 are at conferences in Bulgaria and 2 in journals in English in Bulgaria. There are no citations of publications with the participation of the doctoral student. No documents for protection of intellectual property have been submitted.

1. Relevance of the problem developed in the dissertation in scientific and scientific-applied terms

The dissertation is in a perspective and actual field of the automated systems for information processing and control - modern methods, means and technologies for group control of robotic means for transport of cargoes.

There are many publications and studies on this topic around the world, as well as various solutions, but in our country and in practice they are rare. All this determines the relevance of the research in scientific and applied terms.

2. Degree of knowledge of the state of the problem and the literary material and creative interpretation of the literary material.

A detailed overview of types of modern methods, tools and technologies for the study of group control of robotic vehicles for freight transport.

The work cites 101 sources, has 9 own publications. The analysis shows that the author has studied and thoroughly knows the situation and problems in this area. The

conclusions of the review and analysis are appropriately systematized. The aim and tasks of the dissertation are presented correctly.

3. Correspondence of the chosen research methodology and the set goal and tasks with the achieved contributions

The dissertation theoretically researches and practically develops an approach for solving the set task, as the obtained results demonstrate that these methods can be successfully used for obtaining new results in the research of real products, with better quality of the results and without damages the object.

The conclusions from the review and analysis are well systematized, and the purpose and tasks of the dissertation are presented reasonably and motivated. It can be concluded that the author has selected and applied an appropriate research methodology according to the set goals and objectives.

4. Characteristics and evaluation of the dissertation.

The dissertation makes a good impression with in-depth knowledge of the problems, the use of appropriate approaches to describe physical phenomena and processes in various methods for testing types of efficiency, the formulation of original algorithms and tools to improve the quality of results. A rich experimental material on the results of the application is presented and there is a coincidence between the theoretical preconditions and the results of the experiments.

The Introduction, the Literary review, the review of factors influencing the mobile robots is in the volume of 37 pages. The description of the existing methods and means for group control is a total of 34 pages. Both chapters are made with great precision and detail, which shows a thorough knowledge of the subject by the author. I appreciate the study of European and American experience on the subject.

The tasks of the doctoral program are formulated after critical analysis and systematization of methods and means for research and improvement of the existing efficiency.

The aim of the dissertation is to study the types of group control of mobile robots and to propose innovative approaches for group control of non-holonomic mobile robots with application in robotic means of transport of goods.

To achieve this goal, the following tasks should be solved:

1. To review, analyze and systematize types of mobile robots and methods and tools for group control.

2. To explore known approaches for group control of non-holonomic mobile robots such as "following the leader" and in a distributed formation.

3. To propose structure, organization and composition of a system for group control of non-holonomic mobile robots.

4. To propose innovative approaches for construction of robotic means for transport of goods with group control.

5. To conduct experiments for group control of robotic means for transport of goods in different modes. The results to be analyzed.

I appreciate the reliability of the research and the contributions made.

5. Scientific and scientific-applied contributions of the dissertation work.

I accept the contributions formulated by the author, which are scientifically applied and applied. Some consolidation and refinement could be done. The orientation of the research towards conversions for specific users makes a good impression.

- A comparative analysis of existing methods, approaches and tools for identifying the main factors influencing mobile robots.

- The structure, organization and composition of a system for centralized / distributed group control of non-holonomic mobile robots is proposed.

- An innovative approach to building a control system for group control using the ROS operating system and the Webots simulation environment is proposed.

- An innovative approach has been proposed for the construction of a robotic vehicle for transporting loads of large dimensions and weight.

- Experiments and simulations were conducted with the innovative approach and structure for group control of robotic means of transport of goods with one leader in different modes. The results are analyzed.

- Experiments and simulations were conducted with the innovative approach and structure for group control of robotic vehicles for transport of goods with several subordinate leaders in different modes. The results are analyzed.

The indicated scientific-applied and applied contributions can be referred to the groups: **proving with new means of essential new aspects of already existing scientific fields, problems, theories, hypotheses; creating new classifications, methods, constructions, technologies and obtaining confirmatory facts, constructions and methods and enriching the existing knowledge with practical application.**

6. Assessment of the degree of personal participation of the dissertation in the contributions.

The dissertation and its contributions are the personal work of the doctoral student. I have direct impressions of the good work of the doctoral student and the depth in entering this new and interdisciplinary field.

7. Evaluation of the dissertation publications

In connection with the dissertation 9 publications were made. It can be concluded that the results have become known to the scientific community. The publications well reflect and promote the work done and the results obtained.

8. Significance of the results of the dissertation work in science and practice

The applied methodologies, research and developed solutions can be used for testing in the development and optimization of various technologies for group control of mobile robots. They are a good prerequisite for expanding the work on the topic with other similar types of methods and for commercialization of scientific results.

9. Assessment of compliance of the abstract with the requirements for its formation

The abstract meets the requirements for its design, corresponds to the content of the dissertation and presents exactly the main achievements in the dissertation.

The previously submitted copy lacks a second page and a summary in English.

10. Opinions, recommendations and remarks

The dissertation is characterized by depth, precision, striving to study the interdisciplinary problem from different points of view and finding a working practical solution. The studied area is relevant with prospects for further development.

I had remarks and recommendations to the dissertant, communicated personally and taken into account.

As a recommendation for future work, it would be good to focus more of your own publications in prestigious international journals, as well as the protection of intellectual property.

CONCLUSION

The author has made an in-depth review and analysis of the problem and has proposed solutions in a new and promising area. **All the requirements of the Academic**

Staff Development Act in RB, the Regulation for its application, as well as the specific requirements for obtaining scientific degrees in IICT-BAS in terms of scope, volume and quality of the dissertation are met. On these grounds, I appreciate the work and offer it to the **mag. eng. Milena Filipova Grueva to be awarded the educational and scientific degree "Doctor" in field 5. Technical sciences, direction: 5.2. Electrical engineering, electronics and automation, scientific specialty: Automated systems for information processing and control.**

July 15th, 2020

(Prof. Dr. T. Neshkov)